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The Advance of Electrochemistry

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THE ADVANCE OF ELECTRO-CHEMISTRY.*

By J. W. Richards.

If electro-chemistry concerned itself only with the study of phenomena and their classification, the deduction of laws and the building of theories thereupon, it would satisfy one of the fundamental needs of the human mind, that of *knowing*, but would leave unsatisfied another and equally vital desire, that of *using*.

The various items in which, in industrial chemistry and metallurgy, electro-chemical methods have either superseded ordinary non-electric methods, or else have created new industries, form a catalogue sufficiently long to arrest the attention of the most superficial observer, and altogether too long to be mentioned in detail within the limits of this address. Suffice it to mention in passing the millions of dollars' worth of copper electrolytically refined, not annually, but monthly; the 100,000 horse-power consumed in producing calcium carbide; the reduction of the cost of aluminium from $5 a pound to 30 cents; of sodium in almost an identical ratio; the revolution being wrought in one of the largest chemical industries by the production of electrolytic alkali and bleach; the capturing of the potassium chlorate industry and the manufacture of phosphorus.

The whole story, if related at length, would be the old story of *homo sapiens* having discovered a new tool, a new instrument wherewith to torture mother nature; a new means of reaching old or of creating new results, and he is necessarily immersed in enthusiasm for this "genius of the lamp," which has performed so many wonders and promises so many more. For the use of electricity puts at our disposal temperatures never before industrially attained; gives us a decomposing agent at whose bidding the most powerful chemical compounds resolve into their constituents; enables us to attack and solve chemical problems in a manner before unthought of; opens up a world of possibilities whose scope we even yet but dimly comprehend. This is the fascination of the subject, the attractive force, the absorbing interest which is reflected in the enthusiasm of the electro-chemist for his profession.

Basing our remarks upon present developments, it may be perceived, to start with, that the electrical methods in chemistry and metallurgy which are most successful are either, *first*, those applied to the more powerful chemical compounds, whose decomposition by non-electric methods is highly difficult and expensive, or else impossible; or, *second*, those applied to new fields of very high temperature reactions impossible of attainment by other means; or, *third*, those applied to ordinary chemical processes, in which the directness of the electrical influence, be it decomposing, reducing or perducing, can not be duplicated or competed with by known non-electric methods.

Primitive man took his first lesson in metallurgy by learning to make iron; to this the ancients added lead, copper, silver, gold and even the volatile mercury. Many centuries later zinc was distilled, and only in the most recent times have sodium, aluminium and magnesium been possibilities. Painfully and slowly alchemy and modern chemistry toiled up the heights of the electro-chemical series, from the easy conquest of the *noble* metals

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to the powerful mastery of the *strong* metals, and the steepest part of the ascent has been lightened by the aid of electricity, which has in many cases furnished the easy path to the conquest of the most difficult chemical problems.

It is related of our renowned geologist, Clarence King, that he was an enthusiastic mountain climber, and having from a distance spied a steep mountain, he conceived the ambition of conquering it. Taking a respite from surveying, he equipped himself for difficult climbing, and after several hours of desperate effort finally stood on the summit of the seemingly impregnable butte, only to find an easy trail leading up on the other side.

The most abundant materials in nature are the fixed, difficultly transposable compounds of the strong metals, and their conquest and utilization are the peculiar and special province of electro-chemistry.

According to the estimate of the indefatigable chemist of the Geological Survey, F. W. Clarke, silicon oxide forms 58.3 per cent of the contents of the solid crust of the earth aluminum oxide 14.7 per cent, iron oxide 7.8 per cent, calcium oxide 5.3 per cent and magnesium oxide 4.5 per cent; or, expressed in another way, silicon 27.2 per cent, aluminum 7.8 per cent, iron 5.5 per cent, calcium 3.8 per cent, and magnesium 2.7 per cent.

With these figures in mind, may I not ask whether we fully realize the significance of one of the latest electro-metallurgical triumphs, the production of metallic silicon on a large scale in the electric furnace at Niagara Falls by Mr. F. J. Tone? While the catalogues of dealers in rare chemicals are still listing silicon at dollars an ounce, an electro-chemist has two barrelfuls of it which he is wondering if any one will buy at a fraction of a dollar a pound! Could anything better illustrate the revolutionary character of the electro-chemistry?

To say a word or two more about silicon. I had a somewhat uncanny feeling when Mr. Tone introduced me to his half a ton of silicon. "Here is," I soliloquized, "the first chance which mankind has had to utilize the most abundant solid element on earth. What will be made of it? Can it become as useful as iron? Probably not. Can applications be found for it which will bring it among the ordinary metals of every-day life? Possibly. In any event, here is the material, ready to hand, and no one but the electro-chemist could have made it."

Something of the same feeling must have arisen in the mind of the chemists who first made aluminum a commercial possibility, but his expectations, based on his chemical process, were only actually realized when the electro-chemist gave his solution of the problem. This very element illustrates one of the chief characteristics of electro-chemical processes, viz., their potentiality for improvement. Chemically produced aluminum was out of the race when the metal sold for one dollar per pound, yet the present market price is only one third of that. After the chemical process has done its utmost, has said its last word, the electro-chemical process, which supersedes it, has only *begun* its march of improvement.